ECONOMIC ASSESSMENT OF MANAGEMENT OPTIONS FOR WASTE OIL

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August 1988

ISBN 0-7729-3844-X

93-01896/

"ACKNOWLEDGMENT AND DISCLAIMER"

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ABSTRACT

This report provides the results of an economic assessment of management options for waste oil. The objectives of the study were to:

- o enumerate and characterize firms engaged in the management of waste oil in Ontario;
- o describe the waste oil management system, and the factors that determine how it operates;
- o describe and evaluate a range of management options for improving waste management in Ontario and assess the implications to the waste oil management industry of implementing the options described.

To fulfil these objectives, the study team reviewed the existing literature and analyzed all available government data sources, in particular, information from the Ministry of Environment's generator registration and manifest files for wastes specified under Regulation 309. Also, numerous interviews were conducted in person and by telephone with representatives from all segments of the waste oil industry, namely: oil collectors, re-refiners, road oilers and municipalities.

From these sources it was estimated that in 1987 approximately 250 million litres of waste oil was generated in Ontario, of which 40 million litres were disposed of on-site and 104 million litres were sent off-site and manifested. Of the remaining 106 million litres, 33 million litres, not requiring manifests, were collected by re-refiners and 71 million litres were disposed of by other, unrecorded means.

In 1987, approximately 38 million litres of waste oil were shipped off-site for dust suppression. Approximately 54 per cent of the waste oil that was re-refined in Ontario was imported from the U.S.A. (53 million litres) and Quebec (22 million litres).

Until 1987, when Canam Oil Services announced its withdrawal from the market, the company accounted for approximately 56 per cent of the oil supplied for road oiling. Another 7 companies accounted for 40 per cent of the oil used for dust suppression, and the remaining 4 per cent was applied by another 18 companies.

About 30 companies have applied for approval to apply waste oil to public roads for dust suppression, but only 5 of them, employing 21 people, rely on road oiling as their main form of business.

Three companies re-refine oil in Ontario, one of which, Corundol Oil, operates primarily as a custom oil cleaner and blender. Oil Canada reports that without a subsidy they will close. If they close, Breslube will probably take all the waste oil being re-refined at Oil Canada and reduce out-of province imports.

The following table summarizes the evaluation of several waste oil management options.

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Ce rapport présente les résultats d'une analyse coûts-avantages de divers systèmes de gestion des huiles usées. Les objectifs de l'étude étaient les suivants :

- dresser la liste des entreprises qui s'occupent de gestion des huiles usées en Ontario, en les caractérisant;
- décrire le système de gestion qu'elles emploient et les facteurs qui déterminent leur fonctionnement;
- décrire et évaluer diverses options qui permettraient d'améliorer la gestion des huiles usées en Ontario et établir les répercussions de leur mise en oeuvre pour l'industrie.

À ces fins, l'équipe a repassé la documentation existante et a analysé toutes les sources de données dont dispose le gouvernement, en particulier les renseignements du ministère de l'Environnement sur les producteurs et les manifestes des déchets précisés dans le Règlement 309. L'équipe a aussi procédé à de nombreuses entrevues, en personne et par téléphone, avec les représentants des divers secteurs de l'industrie : collecteurs, recycleurs, épandeurs et municipalités.

Ces démarches ont fait ressortir qu'environ 250 millions de litres d'huiles usées auraient été produits en Ontario en 1987. Là-dessus, 40 millions de litres ont été éliminés sur place et 104 millions ont fait l'objet d'un manifeste et été transférés. Des 106 millions de litres qui restent, 33 millions pour lesquels un manifeste n'était pas exigé ont été collectés par des recycleurs et 71 millions ont été éliminés par d'autres moyens non consignés.

En 1987, environ 38 millions de litres d'huiles usées ont été expédiés hors des lieux aux fins d'épandage sur les routes. Quelque 54 % des huiles usées qui ont été recyclées en Ontario provenaient des États-Unis (53 millions de litres) et du Québec (22 millions de litres).

Jusqu'en 1987, année où elle annonçait qu'elle se retirait du marché, la société Canam Oil Services fournissait à peu près 56 % des huiles destinées à l'épandage sur les routes. Sept autres entreprises en fournissaient ensemble 40 %, les 4 % restants provenant de 18 autres compagnies.

Une trentaine d'entreprises ont demandé l'autorisation de pouvoir appliquer des huiles usées sur les voies publiques aux fins de dépoussiérage, mais seulement cinq d'entre elles, dont l'effectif réuni s'élève à 21 personnes, vivent essentiellement de l'épandage d'huile sur les routes.

L'Ontario compte trois entreprises de recyclage des huiles usées. L'une d'elles, Corundol Oil, s'occupe surtout de les nettoyer et les mélanger. Oil Canada signale qu'elle fermera ses portes si elle n'obtient pas de subvention. Si tel est le cas, la Breslube prendra probablement les huiles que recycle Oil Canada et réduira ses importations.

Summary of the Evaluation of the Management Options

CRITERION	MANAGEMENT OPTIONS				
	Tighter Specification for road oil	Prohibition of road oiling	Used oil fuel specifications	Subsidies to re-refiners	Subsidies to used oil collectors
1. Impact on sources and fates of used oil	Depends on the specification. If demetallizing required, benefits re-refiners. If only 252 permitted, increases competition for that class of oil.	Re-directs oil to re-refiners and fuel uses, displacing imports.	No significant effects on sources and fates	No significant effects on sources and fates.	Increases Ontario oil collected, and decreases imports for re-refining.
2. Impacts on costs to each sector	Generators pay more, second and third tier road oilers have trouble competing. Re-refiners benefit if all road oil must be treated before use, but suffer if their supply of waste type 252 is reduced.	Generators' costs are increased: e.g. $300 000 in Northern Ontario, $200 000 to the shipping industry. Severe hardships for five second tier road oilers. Dust suppression costs for municipalities increased by up to $9.2 million per year.	Small generators burning used oil on-site will have to pay more for virgin fuel.	Oil Canada avoids going out of business; other re-refiners become profitable.	Financially strong collectors better off; weak suffer. Generators' costs reduced.
3. Impact on employment in each sector.	Not significant	Loss of 21 jobs in the road oiling industry.	Loss of jobs in equipment supply industry.	Avoids loss of about 50 jobs.	Some increased employment to collect previously uncollected oil.
4. Ease of implementation	Extension of existing practices.	Difficult in Northern Ontario where few alternative fates available. Difficult for municipalities with sandy soils.	Not difficult	Difficult to distribute subsidies to avoid subsidizing out-of-province oil.	Difficult to avoid subsidizing areas not needing subsidies.

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CHAPTER 1.

INTRODUCTION

1.1 Background

Lubricating oils are widely used in all sectors of the economy in Ontario. Approximately 50 percent of this oil eventually becomes a waste that must be re-refined, used as fuel, applied as a dust suppressant on public roads or on private land, or taken to a disposal facility. A portion of this waste oil is also disposed of illegally.

From an environmental and resource conservation point of view, some of these ways of dealing with waste oil are preferable to others. The most favoured is re-refining because it effectively extends the useful life of the oil by the greatest amount and entails the lowest environmental risk. However, due to the decline in the price of crude oil in recent years, re-refined oil has become less competitive in relation to oil refined from virgin crude to the extent that one or more re-refiners in Ontario may be obliged to cease their re-refining operations. At the same time, the increased sensibility of society to environmental matters has raised questions about the acceptability of using waste oil as a fuel and as a dust suppressant.

The Ontario Ministry of the Environment is currently examining options pertaining to the management of waste oil and this study identifies and assesses the economic implications of these management options.

1.2 Objectives

The objectives of the study are to identify and analyze relevant data on the economic implications of management options for dealing with waste oil. In particular, the study:

- enumerates and characterizes firms engaged in the management of waste oil in Ontario
- describes the waste oil management system, and the factors that determine how it operates
- describes and evaluates a range of management options for improving waste management in Ontario and assesses the implications to the waste oil management industry of implementing the options described.

The study findings will assist the Ministry in determining the best approach to the management of waste oil in Ontario.

1.3 Methodology

The study consists of two major components: a description of the existing system for managing waste oil in Ontario, and a description and analysis of the economic implications of five options which the Ministry is considering for improving the way that waste oil is managed in Ontario. The existing system is described in Chapter 2, the options in Chapter 3.

1.3.1 The Waste Oil Management System

The companies involved in the waste oil management system were identified from Ministry of the Environment data. Companies currently handling waste oil were identified by reviewing data from the Ontario waste manifest system for the period 1 July 1986 to 30 June 1987. Road oilers were identified from applications for dust suppression Certificates of Approval.

All road oilers, oil collectors and re-refiners identified from these sources were contacted for information on quantities of oil handled and prices. In addition, a sample of municipalities representing a variety of sizes, regions and soil conditions was surveyed.

From these published data, and data collected in the surveys, a description of the existing system was developed. It should be noted that, unless otherwise stated, the statistics reported in the study were collected in the Fall of 1987 and relate to that time.

1.3.2 Waste Oil Management Options

In consultation with the Ministry, five generic management options were identified:

- setting more stringent specifications for waste oil to be used as a dust suppressant
- prohibiting the use of waste oil as a dust suppressant on public roads
- prohibiting the use of waste oil as a space heating fuel
- providing subsidies to the re-refining industry
- providing subsidies to collectors of waste oil.

The likely effects of each of these on the sources and fates of waste oil and on costs and employment in each of the waste oil industry sectors were assessed based on the system description developed, and on consultation with road oilers, oil collectors, municipalities and the re-refiners.

1.4 Scope of the Project

The scope of the project was limited to an economic assessment of the management options; environmental benefits were not explicitly addressed. Before choosing one of the options, the Ministry of the Environment will need to combine the analyses reported here with an assessment of the environmental significance of current and alternative practices.

In addition, the management options are defined in a fairly general way. Further details on the proposed options need to be developed if impacts are to be more precisely characterized.

CHAPTER 2.

THE WASTE OIL INDUSTRY IN ONTARIO

This chapter describes the industry involved in the management of waste oil in Ontario. This is done from three perspectives:

- o the sources and fates of waste oil
- o the structure of the industry
- o the waste oil management system

2.1. Sources and Fates of Waste Oil

2.1.1. Sources of Waste Oil

In addition to their use as a fuel, oil and oil products are used in significant quantities as a material, much of which eventually becomes waste. Special formulations of oil are developed for use as lubricating oils, hydraulic oils, transformer oils, and for other material uses. In 1986, Statistics Canada reported sales of 489.6 million litres of lubricating oil in Ontario. Details of these sales are presented in Table 1.

As indicated in Table 2, about half of the quantity of lubricating oils and greases sold is used in the manufacturing sector. Although only 20 per cent is attributed to the transportation sector, it has been estimated that the other half of the oil is primarily used in vehicles.[1]

In the process of use, these oils change their chemical and physical properties and need to be replaced. For example, automobile engine oil eventually collects particles of metals and dirt and must be changed to avoid engine damage. It has been estimated that about half the volume of lubricating oil is used up in service, either burned in combustion engines, or, in the case of grease, "exhausted" in the bearings (Elliot, 1986). This assumption suggests that about 250 million litres of waste oil were generated in Ontario in 1986.

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1 Sectoral distribution is from data provided by the major suppliers of lubricating oil and greases. In some cases, the reported sectoral breakdown may not correspond with actual end-use. For example, oil sold to retail outlets for use in automobiles may be reported as commercial.

TABLE 1

ONTARIO PRODUCTION AND SALES OF LUBRICATING OIL

		1986 Million Litres	
1	Production	534.6	+
2	Inter-product transfers	0.5	+
4	Transfers to Refinery Feed	74.6	-
5	Imports	76.6	+
6	Exports	24.4	-
7	Interprovincial - in	88.7	+
8	Interprovincial - out	188.3	-
	Opening inventory	192.3	+
9	Closing inventory	185.4	-
10	Rec. from Non-Reporting Companies	92.8	+
11	Rec. from Reporting Companies	98.9	+
12	To Reporting Companies	100.4	-
13	Losses and adjustments	21.2	-
14	Own Consumption	0.8	-
15	Domestic sales	489.4	=

Source: Statistics Canada, 1987. Refined Petroleum Products. Report 45-004 (February).

TABLE 2

ONTARIO LUBRICATING OIL SALES (Million Litres in 1986)

Mining Agriculture	12.6
Forestry	2.4
Agriculture	33.4
Construction	8.8
Sub-total primary industry	57.2
Manufacturing	249.6
Transportation	104.4
Public administration	4.0
Commercial & institutional	73.9
Sub-total service sectors	77.9
Statistical difference	0.2
TOTAL	489.3

Source: Statistics Canada. 1987. Quarterly Report on Demand and Supply. Report 57-003. (4th Quarter 1986).

2.1.2. Fates of Waste Oil

As with most waste materials, accounting for the quantities of waste oil has historically been limited. When the oil has little or no economic value, and there is no regulatory requirement to account for its disposition, there is little incentive to do so.

In recent years, the Ministry of the Environment has required industrial generators to report the quantities of waste oil generated, and has required transporters of waste oil (with some exceptions, notably shipments from service stations) to manifest their cargos. The manifest data for July 1986 through June 1987 and the generator registration data account for about 210 million litres of used oil and oily waste[2]. The distribution of this quantity by fate is presented in Table 3 and Table 4.

Unfortunately, this number of 210 million litres cannot easily be compared with the 250 million litres referred to above because although they both refer to waste oil the quantity reported on the generator registration and manifest databases refers to not just oil but also oily wastes and oily waters. In order to relate the waybill quantities to the quantities of waste oil generation estimated from sales, it is necessary to make a number of assumptions about the characteristics of oil going to the various fates.

Large quantities of waste classes associated with used oil (Ministry of the Environment classes 251 to 254) are reported as going to water pollution control plants (WPCP) or sewers; this material is most likely primarily water. Sewer use by-laws limit the amount of oil and grease that is permitted to be discharged with water. An upper bound estimate is probably about 10 per cent oil.

Similarly, significant quantities of waste class 251 are sent to landfill: this waste is probably a sludge or solid waste from processing of used oils. Wastes in this group are probably not more than 40 per cent oil.

Other destinations require a fairly high oil content; waste oil used for dust suppression must be 95 per cent oil to be acceptable to some customers. Oil used as a fuel and in re-refining should also have a low water content, though receivers of oil for these purposes may do some de-watering of the oil received. A reasonable estimate for oil content is probably about 90 per cent for these destinations.

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2 This is made up of:
55 717 k on-site
75 969 k generators to final destinations
and 78 279 k intermediate to final destinations

TABLE 3

FATE OF WASTE OIL IN ONTARIO
(Million Litres/Annum)

	On-site	Off-site Manifested	Off-site,not registered	Total
Export		4	3	7
Misc. Receivers		14		14
Fuel	1	1		2
Re-refiners		33	33	65
Waste T&D	11	5		16
Dust Suppression	24	38		62
Landfill	3	7		10
Sewer/WPCP	<1	3		3
Other	1		71	72
Total Ontario	40	104	106	250
Imports		60	15	75
Total	40	164	121	325

Notes:

1. Data represent the oil component of MOE waste classes 251 to 254 inclusive.

2. On-site quantities and off-site manifest quantities are calculated from Table A-1 and Table A-2 respectively using the waste density and oil fraction assumptions in Table A-3.

3. Dust suppression includes road oiling and other activities, such as dust suppression on coal piles. "Other" on-site is storage, off-site includes disposal of oil by the do-it-yourself sector, some resource industries in Northern Ontario, and sparsely populated areas

4. Estimates of quantities outside the manifest and registration systems for re-refiners and imports are based on surveys of the re-refiners. "Other" is derived by subtracting known fates from the total quantity estimated in Section 2.1.1.

Using these assumptions, Table 3 provides an estimate of the current fate of waste oil in Ontario. More detailed information from the Ministry of the Environment's manifest information system and generator registrations is provided in Appendix A.

2.2. The Industry Structure

Once the oil is no longer suitable in its intended use, it becomes a waste to the original user. However, the oil often maintains value for other uses, either as a lubricating oil refinery feedstock, a fuel, or for uses less demanding of purity including dust suppression, manufacturing asphalt, as a sunscreen for pigs, as a pesticide or pesticide carrier, and as a vehicle undercoating. In other cases, the oil may be too contaminated for alternate uses, or the generator may be unaware of readily available receivers for the waste oil and may direct it to waste treatment or disposal.

As noted above, most of the waste oil that does not go to a waste treatment and disposal facility is used for one of three uses: as a feedstock to an oil re-refinery, as a dust suppressant on roads[3] or as a fuel. Specific industries support each of these three end-uses of waste oil. In addition, the industry is supported by collectors who may be exclusively carriers, may bulk and transfer the oil, may provide limited pre-processing or may also be responsible for the final use of the waste. In the following sections, four primary components of the waste oil industry are discussed:

- oil collectors
- road oilers
- re-refiners
- fuel blenders.

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3 Significant quantities of waste oil are also used as a dust suppressant on coal piles. The Regulation 309 manifest system indicates that between 1 July 1986 and 30 June 1987 Dofasco received more than 14 million litres of waste oil for use as a dust suppressant. Ultimately much of this oil is burned with the coal and its heating value is recovered.

2.2.1. Oil Collectors

The following discussion is based entirely upon interviews with representatives of waste management companies that handle waste oil, emulsions and oily waters.

Collectors of waste oil can be divided into two groups: those that collect it for their own use and those that collect it for use by others. The first group consists almost entirely of re-refiners and road oilers. In both cases their major source of revenue comes from the end use of the waste oil, and collection is an expense that is necessary to support their main business. More than 70 percent of the waste oil collected by this group is crankcase oils supplied by service stations, fleet operators and operators of heavy equipment. Re-refiners are in the collection business to ensure that they maintain a consistent flow of feedstock for their refineries. Road oilers collect waste oil to ensure that they have adequate supplies of oil during the road-oiling season (May to September) and to keep their equipment and staff busy during the off-season.

The second group of waste oil collectors are waste management companies that provide a service to generators for a fee. The fee includes transportation, treatment and final disposal of waste oil, emulsions and oily water. All of the waste management companies provide collection and transfer station services. A number of them also operate waste water treatment plants that can handle oily waters. Once the oil, oil emulsions, and oily waters have been collected, bulked at transfer stations and treated, as necessary, the waste management companies transfer the oil to final users. For some oils the waste management companies receive payment, but in most cases the final user must be paid to take the oil. Waste management companies deal primarily with industrial generators of oil. They collect very little crankcase oil.

The major waste management companies that handle, but are not final users of waste oils, and their location are as follows:

Company	Location
Canflow Services	Corunna
Cantro Oil Recoveries Ltd.	Windsor
CPW Disposal	Barrie
Environmental Management Corporation	London
Jim's Trucking	Welland
O.E. MacDougall Liquid Waste Services	Brockville
Ontario Waste Oil	Mississauga
Palro Liquid Waste Removal	Brantford
Retek Resource Recovery Inc.	Brantford
Quantex Chemical Inc.	Kitchener

All but two of the above were surveyed for this study.

The waste management companies collect and treat, in total, an estimated 60 million litres per year of waste oils, oil emulsions, and oily waters. After the water and other impurities have been removed, approximately 15 million litres of oil remains.

Unless a generator has a high quality waste oil that can be sold as a fuel or to a re-refiner without any treatment, waste management companies charge generators to take away their oil waste streams as of October, 1987. The fee starts at 7 cents per litre plus transportation costs. Waste management companies that operate trucks and transfer stations, but not treatment facilities, invariably have to pay treatment facilities to take their oil waste streams.

Once the oil waste streams have been treated, the oil that is recovered is disposed of in markets that bring the highest price or impose the least cost. The recovered oil, in most cases, can be sold to road oilers and as a fuel if it is suitable for road oiling or as a fuel, respectively. If the recovered oil is sent to a re-refiner, about the best the treatment facility can expect is that the re-refiner will take it without either paying or charging. In most cases, re-refiners are charging treatment facilities to take the reclaimed oil.

Of the 15 million litres of "clean" and reclaimed oil that is handled by waste management companies, approximately equal portions end up as road oil, fuel, and refinery feedstock. A small amount is disposed of in hazardous waste incinerators.

In addition to financial considerations, waste management companies cite a number of other factors that are important in deciding the fate of waste oil in their possession.

- **Transportation costs** - Waste oil has a relatively low value. If it has to be transported long distances, transportation costs will exceed the amount that final users are willing to pay for it.

- **Composition of oil** - To be suitable for road oiling, waste oil cannot contain more than 5 ppm PCBs. Re-refiners will not accept waste oil with a PCB concentration higher than 50 ppm. Only oils with a high heat value are suitable for burning.

- **Legal concerns** - Some generators are showing a preference for having their waste oil burned as a fuel because of concerns about liability for proper disposal.

- **Availability of alternatives** - In some cases there are few alternative fates for waste oil due to transportation costs, the composition of the oil, and its value.

With one or two exceptions, virtually all of the oils, emulsions and oily waters handled by Ontario waste management companies come from generators located in Ontario. Less than 15 percent of the total is brought in from

out of province. Most of the waste management companies reported an increase over recent years in the amount of oils, emulsions and oily waters collected. The main reasons given for the increase were changes in legislation -- implementation of Regulation 309 --, generators changing their waste management practices and economic growth.

Two of the waste management companies derive essentially all of their revenues from collecting and treating waste oil. The portion of revenue accounted for by waste oil collection and treatment by the remaining companies ranges from less than five percent to 60 percent. The other portion of their revenues comes from transportation and transfer station services for liquid and industrial wastes.

2.2.2. Road Oilers

Road oilers that apply oil to public roads can be divided into three tiers, according to size: companies with more than 10 employees involved in road oiling; companies with between two and ten full-time employees involved in road oiling, and companies with less than 2 full-time employees involved in road oiling. (See Table 4.)

Only one company, Canam Oil Services, qualifies for the first tier.

The second tier of road oilers consists of seven companies that, amongst them, applied approximately nine million litres of road oil during 1986. The companies in the second tier are engaged in both collecting waste oil and applying it as a dust suppressant.

The third tier consists of 17 organizations whose primary concern is an activity other than road oiling but who have applied for dust suppression Certificates of Approval. The organizations include municipalities, a provincial government ministry, and private sector firms. To most organizations in this tier, road oiling accounts for a relatively minor portion of their activities. This group applies less than one million litres of road oil per year.

Each of the three tiers is discussed in greater detail below.

2.2.2.1. The first tier: more than 10 employees

Canam Oil Services was, by far, the largest road oiler in 1986, and is the only company in the first tier. During 1986 Canam and its sub-contractors applied 12.7 million litres of road oil in Ontario or approximately 56 percent of the total. Canam announced in August, 1987 that it was terminating its road oiling activities. The main reason given by Canam for leaving the road oiling business was its concern about the inadequacy of the standard for composition of road oil.

TABLE 4

ONTARIO ROAD OILERS

The first tier

Canam Oil Services

The second tier

A-1 Sewage Services Ltd.
Chambers Road Oil Ltd.
Da-Lee Dust Control
FAW Oil Ltd.
Keith R. Thompson Ltd.
Marine Clean Ltd.
Woodington Systems Inc./Norjohn Ltd.

The third tier

Edward Fuels Ltd.
H. Wellwood & Sons Ltd.
J.R. Oil Sales/Orenda Oil Carriers
Morard Pulpwood Co, Ltd.
North Star Pumping/Willy's Sanitation
Pebblestone Multi-Services, Inc.
R & R Sanitation and Delivery Services
Richard R. Gingerich
Robertson Pumping Services Limited
Soo Septic Service Ltd.
Trenton Gravel Products
Municipality of Paipoonge
Township of Brighton
Township of Brighton
Township of Glackmeyer
Township of Hope
Township of Prince
Ontario Ministry of Natural Resources

Notes: Listed companies have submitted an application for a Certificate of Approval for applying waste oil as a dust suppressant, Ontario Ministry of the Environment, Approvals Branch, as of September 1987.

2.2.2.2. The second tier: 2 to 10 employees

With Canam Oil Services no longer in the road oiling business and the small volume of road oil applied by the third tier of road oilers, the oil collectors/road oilers in the second tier will be the ones most affected by any changes in road oiling regulations. These companies are listed in Table 4. All of these companies have Certificates of Approval as transfer stations or reclaimers, in addition to having or having applied for a dust suppression approval. All were surveyed for this study. The discussion that follows is based on the results of the survey.

The sources of waste oil and the amount collected from each are as follows:

Sources of Waste Oil Waste in Road Oiling

Source	Amount (kL)	Percent (%)
Engine lubricating oil	4 700	51
Industrial oils	500	5
Ships	1 800	20
Transfer stations	2 200	24
Total	9 200	100

With few exceptions all of the waste oil collected was used for road oiling. The exceptions are: one company sold about 90 percent or 400 000 litres of the engine oil, that it collected from service stations, for use as a fuel (this amount is not included in the table above); another company sold the occasional load of waste oil to a re-refiner, and a third sold the occasional load of waste oil for use as a fuel. The two last-mentioned fates account for less than 5 percent of the total.

The waste oil purchased from transfer stations were industrial oils and oils reclaimed from emulsions and oily water.

Waste oil from ships comes from three different sources. The main source is the ship's used oil tank. Over the last ten years most lake freighters have been converted to burn a mixture of bunker and diesel oils. Up to 80 percent of the fuel consists of bunker oil. In order to burn this mixture in marine diesel engines, ships are fitted with a system to purify the bunker oil before it is mixed with the diesel and injected into the engines. The residues from the purification process, which are unsuitable for re-refining, are routed to the used oil tank. The second source of waste oil is the lubricating oil used by the ship's main and auxiliary engines. Waste lubricating oil, generated during the shipping season is also stored in the used oil tank. If the engine oil is changed while a ship is tied up during the winter months, the waste

oil may be taken away directly instead of being dumped into the used oil tank. The third source of waste oil is oily water that is pumped from ship bilges.

The two major factors that affect the price of waste oil collected by road oilers are the size of the generator and the part of the province in which it is collected. In the southern regions of Ontario, service stations typically are charged three cents per litre to have a collector take away their used engine oils. In the Muskoka region, service stations are neither paid nor charged for used oil. In Northern Ontario service stations are paid two to three cents per litre for used oil by collectors. The reasons for the regional price differences is that the demand for road oil in Northern Ontario exceeds the local supply of used oil. The vast majority of the waste oil collected in the Muskoka region and Northern Ontario is used for road oil. During 1986, an additional eight million litres of waste oil was trucked from Southern Ontario to Northern Ontario where it was used as road oil.

The cost to truck waste oil from, for example, Toronto to Sudbury is about four cents per litre. Assuming that the cost of waste oil at the depot gate in Southern Ontario is zero (i.e. the sum of the collection and storage cost is equal to the amount charged generators), collectors/road oilers in Northern Ontario can pay local generators two to three cents per litre for waste oil and still have the same waste oil costs, at the road oiling site, as road oilers who must transport waste oil from Southern Ontario.

Road oilers typically pay large generators and transfer stations three to four cents per litre for waste oil.

Ships are neither charged nor paid for their waste oil. However, the collector/road oiler who services most of the ships of the Great Lakes fleet that call at Southern Ontario ports charges a fee for transporting the waste oil from the ship to his transfer station.

More than 90 percent of the waste oil collected by the second-tier road oilers comes from Ontario sources.

The quantity of waste oil that is collected and applied by the second tier road oilers has grown by about 25 percent in recent years. The main reasons for the growth are that more waste oil has become available for collection following implementation of Regulation 309 and road oilers are collecting from larger areas. Due to the favorable costs and performance of used oil when compared to the main competing dust suppressant -- calcium chloride -- road oilers have apparently not experienced great difficulty in increasing the amount of road oil that they apply.

2.2.2.3. The third tier: less than 2 employees

The previous section noted that all of the so-called first and second tier road oilers all had Certificate of Approvals as either transfer

stations or reclaimers, in addition to their approval as appliers of dust suppressants. Since June 1985, road oilers must be certified by the Ministry of the Environment through waste management Certificates of Approval. About 100 applications have been received by the Ministry. These include the eight first and second tier road oilers discussed above. Most of the remaining applications were from companies seeking approval to apply oil onto their own property.

Applications have been received from seventeen "third tier" organizations seeking approval to apply waste oil to public property. These seventeen, listed in Table 4, include 11 private companies, 5 municipalities and the Ontario Ministry of Natural Resources.

Private companies

Attempts were made to contact all eleven companies. Two of the companies had changed their phone numbers, and/or name and could not be located. Two others indicated that after submitting an application they had decided not to pursue gaining approval. The other companies offer or plan to offer services to municipalities to apply oil to roads for dust suppression purposes.

Of the companies seeking approval to road oil, all derive most of their livelihood from some other activity and road oiling represents a small part of their total revenue; for most of the companies it is under 10 per cent. One company derives about one-third of its revenue from road oiling. All had one truck that was used during the road oiling season to apply waste oil, and for other uses the rest of the year.

The total volume of oil applied to roads by these companies in the past year was about 600 000 L, more than 500 000 L of which was collected from service stations. Although only about one-third of this amount of oil was reported on the manifest system, all companies indicated that samples from all storage tanks were tested for contaminants, usually by the Ministry of the Environment or the Ministry of Transportation and Communications. Two of the companies reported that they used to road oil but did not in the past year. In one instance, their client had switched to the use of Calcium Chloride; in the other the oiler indicated that his market had disappeared because of concern about environmental effects. The others indicated that the quantity of oil applied, and the revenue associated with it had been fairly constant over the last few years.

The prices paid for used oil vary depending on geographic location, the quantity and quality of oil a generator has available, and competitive factors. In some instances, generators were paid up to 0.07 $/L for their waste oil; in others, the generator was required to pay up to 0.044 $/L. Where generators were required to pay for oil removal, they were in southern Ontario; whereas generators who were paid for their oil were in Northern Ontario. Many of the generators served by these road oilers were neither paid nor charged to have their waste oil removed. As noted above, the demand for waste oil (for road oiling) in Northern Ontario exceeds the supply. However, all respondents indicated that the quantity

they collect or road oil would not be affected by a modest change in the cost of the waste oil (plus or minus 10 per cent).

The primary reason given for using oil as a dust suppressant (rather than other materials) was its ready availability. Several companies indicated that waste oil collection was somewhat related to their main business activity of providing pumping services, or supplying virgin oil products, and waste oil had been used as a dust suppressant for a number of years. Except for one company that also applies a small amount of brine, all companies indicated that they were technically capable of switching their vehicles to apply other materials but had never considered doing so, or were not interested in doing so. Concern was expressed about the local availability of alternative dust suppressants. In addition, road oilers collecting from rural areas wondered what would happen to the oil they collect if it was not used for dust suppression; several speculated that it would not be collected.

Municipalities

Of the five municipalities that submitted applications for approvals, only the Township of Prince in Algoma District is using oil as a dust suppressant on public roads. The others were seeking approval only to use oil from their own vehicles in their public works yard, or, in the case of Hope, as an adjunct to a request for approval to use pulping liquors as a dust suppressant.

The Township of Prince gets oil from service stations and local industry for application to 9.2 km of roadways. The Township used liquid calcium in the past, but now uses just oil, applied by municipal staff using a modified milk truck purchased especially for the purpose. The township finds that applying the oil themselves, rather than relying on a contractor, ensures that the oil can be applied when needed. Local industries and service stations are now saving oil for the township, and the township saves on the 6000 $/a that it used to spend on liquid calcium.

Ministry of Natural Resources

The Ministry of Natural Resources sought approval to apply oil as a dust suppressant, primarily oil from aircraft and other service vehicles at remote airports.

2.2.3. Re-refiners

There are three oil re-refiners operating in Ontario: Breslube Ltd., Oil Canada, and Corundol Oil and Grease Inc. Breslube, the largest of the re-refiners, with annual capacity of approximately 100 million litres, is located in Breslau. Oil Canada's capacity is 40 million litres per year. The Oil Canada refinery is located in Toronto. Corundol, which provides contract re-refining services to industry, has annual capacity of about 8 million litres, and is located in Rexdale.

Breslube and Oil Canada re-refine used crankcase and industrial oils to produce end products such as base oils, industrial oils, asphalt extender, engine oils, and fuels. These products are also produced from virgin crude oil at refineries operated by the major oil companies.

Breslube and Oil Canada compete directly with conventional refiners for sales of end products. Re-refiners have very little control over the price of end products; they are essentially "price takers" in markets dominated by the major oil companies. While re-refined oils meet the quality standards of oils refined from virgin crude oil, re-refined oils typically sell for less because of the perception that they are not as good as oils refined from crude oil. For example, re-refined lubricating oil usually sells for two to three cents per litre less, at the refinery level, than a litre of lubricating oil made from crude oil.

At current capacity utilization rates of virtually 100 percent for Breslube and Corundol and about 65 percent for Oil Canada, approximately 140 million litres of oil are being re-refined annually. Of the total amount of waste oil that is re-refined in Ontario, approximately 65 million litres (46%) is collected in Ontario, 22 million litres (16%) is brought in from Quebec, and the remainder, 53 million litres (38%) is imported from the United States. On a company basis, the source of all of the waste oil that Corundol re-refines is Ontario; Oil Canada's waste oil comes from Ontario and Quebec in roughly equal portions; and Breslube obtains about 40 percent of its waste oil in Ontario, 10 percent from Quebec and 50 percent from the United States.

Approximately 80 percent of the waste oil refined by Breslube and Oil Canada is crankcase oil which is collected from service stations and fleet operators. The remainder is from industrial sources. All of Corundol's waste oil is from industrial sources. Both Breslube and Oil Canada operate collection depots in major urban centres in Ontario and Quebec. However, only a small amount of the waste oil collected in Northern Ontario is re-refined. Breslube's collection network extends only as far north as North Bay. Oil Canada obtains waste oil from contract collectors and industries in Northern Ontario, but the amounts are relatively small. The high cost of collection in Northern Ontario and the cost of transportation to Southern Ontario pushes the price of waste oil from Northern Ontario above the price that re-refiners are willing to pay. Most of the waste oil collected in Northern Ontario is used as a dust suppressant where it commands a higher price than as a refinery feedstock.

Control over collection of waste oil is seen by Breslube and Oil Canada as necessary to ensure adequate supply and lowest costs. Through its subsidiaries, Breslube collects more than 90 percent of its waste oil requirements. Oil Canada collects about 80 percent of the oil it re-refines.

When the price of crude oil was U.S.$30 per barrel, re-refiners were paying generators for waste oil. At the current price of about U.S.$18

per barrel for crude oil, re-refiners are charging generators, whenever possible, to take away their used oil. Service stations are typically charged two to three cents per litre, but the charge can be as high as six cents per litre if the service station has a small amount of oil to be picked up and/or it is a long way from the depot. Large generators are typically being paid about two cents per litre for waste oil.

The re-refiners are not experiencing a shortage of waste oil, but the distances that must be travelled to collect enough of it drive up average costs for waste oil at the refinery gate. All of the waste oil that presently can be economically collected in Ontario is being collected. Southern Ontario service stations and large generators are well-served, but re-refiners are collecting only small amounts of waste oil from the do-it-yourself (DIY) segment and from Northern Ontario. Since Ontario provides less than half of the re-refiners requirements, waste oil is being trucked in from Quebec and the United States at considerable expense. According to the industry, in order to maintain refinery operations at the break-even point, the cost of waste oil must be 4 cents per litre or less at the refinery gate. Breslube is apparently just meeting that target. Oil Canada's average refinery-gate cost is considerably above 4 cents per litre. The concept is not relevant to Corundol since it does business on a cost-plus basis.

2.2.4. Fuel Users

There are two types of potential final users of waste oil; operators of industrial combustion equipment, and small facilities using waste oil space heaters.

Waste oil can be used to supplement virgin fuel oil in industrial uses. However, because of the contaminants that the oil may contain, it is most suited for use in high temperature combustion chambers which are equipped with flue gas treatment systems, such as are associated with cement kilns or asphalt plants. Such facilities do use some waste oil for fuel. The manifest system identifies St. Lawrence Cement in Mississauga as a reclaimer of waste oil; it receives more than 1 million litres per year of waste oil for use as a fuel. However, this oil is imported from the United States; no large scale fuel blenders operate in Ontario.

The waybill identifies a number of users of waste derived fuel for the waste classes associated with used oil by a receiver prefix of WDF. For the period 1 July 1986 to 30 June 1987, these companies received about 1.3 million litres, as presented on Table 5.

In addition to use in industrial boilers, waste oil can be used as a fuel in specially designed waste oil space heating burners. Waste oil burners are widely promoted at trade shows and in trade journals. Use of these burners requires a Certificate of Approval under section 8 of the Environmental Protection Act. The Ministry of the Environment has developed a guideline to be used in the assessment of applications for approval of vaporizing type burners fired with waste oils. The guideline

restricts the types of waste oil to hydraulic oil, transmission oil and crankcase oil from diesel engines; prohibits the use of the burners in residential buildings, and restricts the source of the oil to oil generated on the premises of the owner. About 30 transmission shops and diesel engine shops have gained approval (Bell,1987). From the interviews conducted for this project, it appears that a number of waste oil burners are also being used without Ministry of the Environment approval.

TABLE 5

REGISTERED RECEIVERS OF WASTE OIL AS FUEL

	Ministry of the Environment Waste type		
	253	254	TOTAL
Algoma Steel		82 000	82 000
Ashwarren International	44 444	454 800	499 244
Da-Lee Dust Control		17 500	17 500
Quantex Chemical Inc.		364 100	364 100
Steed & Evans		18 350	18 350
Towland (London) 1970 Limited		41 000	41 000
Usarco Limited		323 300	323 300
TOTAL	44 444	1 301 050	1 345 494

Source: Ministry of the Environment manifest system 860701 to 870630 Receivers identified by a "WDF" prefix Assumes waste oil density of 0.9 kg/L

2.3. Users of the Products of the Waste Oil Industry

2.3.1. Users of Re-refined Oil

Re-refining oil produces a high quality base oil which can be used as such, as a feed to lubricating oil production with virgin oil, or enhanced by the addition of appropriate additives and viscosity adjusting stocks for meeting the performance standards of motor oils (Linnard,1979). When re-refined oil has been sold in the consumer market in competition with virgin oil, it has met with some consumer resistance.

Re-refined oil is an attractive feedstock to Canadian virgin oil refineries because of the nature of Canadian oil, which is less suitable for the production of lubricating oil than off-shore oil. It was this consideration that lead Shell Oil to develop the Canadian Oil (now Oil Canada) facility in downtown Toronto.

Re-refined oil is sold in bulk and as packaged, private-brand products. Oil Canada sells approximately half of its output to major oil companies. Breslube exports about 70 percent of its output to the United States. Corundol is primarily a custom re-refiner of industrial oils. Corundol contracts with large-scale users of oils to re-refine the oil and return it to its original specification. In most cases oil streams are segregated; i.e. the oil that is returned to the customer is processed from waste oil supplied by the customer.

If the aggregate of the re-refining fee, transportation costs and other costs, is greater than the aggregate of the cost of new oil and the disposal cost of the waste oil, customers will presumably buy new oil. Re-refined oil commands a price in the marketplace slightly below that for oil refined from virgin feedstocks. A major objective of the Canadian Association of Re-refiners is to gain user acceptance of such oils by ensuring quality control, and through education.

2.3.2. Users of Waste Oil for Dust Suppression

There are three main types of users of waste oil for dust suppression: those using it to control wind erosion of material stocks (e.g. Dofasco's use on its coal piles), use by municipalities on public roadways, and use on private roadways, parking lots or yards. It is the use on public roadways which is the major concern of this study.

About 24 million litres of oil were used as a dust suppressant on public and private roadways over the period between 1 July 1986 and 30 June 1987. Details of this quantity by county or district are presented in Table 6. Oil represents about 14 per cent by volume of all dust suppressants. However, there are varying application rates and frequencies for the various materials. Correcting for these, oil accounts for a slightly larger fraction (about 16 per cent), as indicated

in Table 7.

To understand the factors that went into the decision to use waste oil as a dust suppressant, surveys were conducted of a sample of municipalities representing different geographic locations, different sizes, and using different types of dust suppressants. These indicated that where oil was used, the primary reasons for using it were a perception that oil was cheaper and performed more effectively. The cost of oil applied to the roads by contractors reported by the municipalities surveyed ranged from 0.143 $/L to 0.176 $/L. The costs reported for liquid calcium chloride ranged between 0.10 $/L and 0.154 $/L depending on geographic location. (Pulping liquors are usually obtained at no cost and are applied by municipal staff, and thus it is difficult to compare costs for that material against costs for other dust suppressants.) Many respondents noted that calcium chloride needs to be applied more frequently than oil, and that this more than offset any cost advantage that it might have over oil.[4] Comparing the costs for the two materials requires consideration of not just their application costs, but the rate and frequency of application. Typical annual costs per kilometer are presented in Table 8.

The second major reason given for using waste oil, rather than other dust suppressants was effectiveness. Particularly in sandy soil conditions, where there is a low fine content, calcium chloride does not perform as well as oil. This helps to explain in part the heavy use of waste oil in Muskoka, Parry Sound and Simcoe counties. Municipalities in other counties using more than one dust suppressant often indicated that oil was used in sandy parts of their jurisdiction.

The perceived differences between oil and alternative dust suppressants are quite marked. Most respondents indicated that the quantity of oil used as a dust suppressant would not be affected by a 10 per cent increase or decrease in the cost of applying road oil.

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4 However, none of the oil users noted the lower application rate for calcium chloride relative to oil.

TABLE 6

DUST SUPPRESSANT USE IN ONTARIO

	Waste oil (L)	CaCl (L)	Liquors (L)	Other (L)	To
Brant County	165 512	1 424 413			1 589
Bruce County	386 523	4 167 166			4 553
Cochrane District			2 859 167		2 859
Dufferin County	219 714	2 469 993			2 689
Dundas-Stormont-Glengarry		4 309 608			4 309
Durham Regional Municipality	2 376 716	4 091 400	278 453		6 746
Elgin County	14 181	1 159 230			1 173
Essex		3 198 868			3 198
Frontenac County	119 210	1 742 633	910 851		2 772
Grey County	294 666	4 803 606			5 098
Haldimand-Norfolk Regional Municip.	2 728 733	2 273 000			5 001
Haliburton County	323 076	172 748			495
Halton Regional Municipality	1 392 484	578 826		1 066 520	3 037
Hamilton-Wentworth Regional Municip	1 068 892	1 174 383	23 000	32 558	2 298
Hastings County	54 638	2 863 980	14 592 951		17 511
Huron County	66 279	5 727 960			5 794
Kenora District	43 896		25 278		69
Kent County	108 062	3 535 272			3 643
Lambton County	250 224	3 545 880	40 608		3 836
Lanark County	80 687	1 939 626			2 020
Leeds and Grenville County	79 246	3 126 132	104 420		3 309
Lennox and Addington County	199 796	925 868			1 125
Middlesex County	127 477	3 454 960			3 582
Muskoka District	3 244 074	780 396			4 024
Niagara Regional Municipality	2 493 722	2 803 366		175 681	5 472
Nipissing District	74 469				74
Northumberland County	163 384	939 506	27 337 858		28 440
Ottawa-Carleton		3 106 433			3 106
Oxford County	184 174	4 294 454			4 478
Parry Sound District	1 876 338				1 876
Peel Regional Municipality	414 578	2 779 121	17 403		3 211
Perth County	241 289	3 712 566			3 953
Peterborough County	397 822	2 551 821	4 152 638		7 102
Prince Edward County	1 937 028		9 404 922		11 341
Rainy River District	75 000				75
Renfrew County	56 673	1 682 020			1 738
Simcoe County	1 847 847	3 838 339			5 686
Thunder Bay District	50 429				50
Toronto, Metropolitan	268 501	297 005	69 690		635
Victoria County		3 265 543	104 497		3 370
Waterloo Regional Municipality	716 913	2 159 350			2 876
Wellington County	128 334	4 962 716			5 091
York Regional Municipality	365 316	1 772 940			2 138
TOTAL	24 635 903	95 631 128	59 921 736	1 274 759	181 463

Notes: Source is manifest data for 860701 to 870630.
Calcium chloride data are from Gillham, 1985; total was checked for consistency with 1987 practices.
Total excludes Da-Lee and Dofasco which account for an additional 17.5 million litres.

TABLE 7

DUST SUPPRESSANT USE IN ONTARIO

	Waste oil (km)	CaCl (km)	Liquors (km)	Other (km)	TO (km)
Brant County	15	72			
Bruce County	52	498			
Cochrane District			169		
Dufferin County	20	125			
Dundas-Stormont-Glengarry		354			
Durham Regional Municipality	218	207	16		
Elgin County	2	138			
Essex		382			
Frontenac County	7	143	54		
Grey County	39	573			
Haldimand-Norfolk Regional Municipa	250	115			
Haliburton County	30	9			
Halton Regional Municipality	128	29		74	
Hamilton-Wentworth Regional Municip	98	60	1	2	
Hastings County	3	235	861		1
Huron County	9	684			
Kenora District	4		1		
Kent County	14	422			
Lambton County	33	423	2		
Lanark County	5	159			
Leeds and Grenville County	5	257	6		
Lennox and Addington County	12	76			
Middlesex County	17	412			
Muskoka District	297	40			
Niagara Regional Municipality	229	142		12	
Nipissing District	7				
Northumberland County	15	48	1 613		1
Ottawa-Carleton		255			
Oxford County	25	513			
Parry Sound District	172				
Peel Regional Municipality	38	141	1		
Perth County	32	443			
Peterborough County	36	129	245		
Prince Edward County	113		555		
Rainy River District	7				
Renfrew County	3	138			
Simcoe County	169	195			
Thunder Bay District	5				
Toronto, Metropolitan	25	15	4		
Victoria County		165	6		
Waterloo Regional Municipality	66	109			
Wellington County	12	251			
York Regional Municipality	33	90			
TOTAL	2 244	8 049	3 536	89	13

Notes: Calculated from Table 6 using mean regional application rates and frequencies from Gillham,

TABLE 8

UNIT COSTS OF DUST SUPPRESSANTS ($/km/Annum

Suppressant	Cost ($/L)	Application Rate (L/km/Application)	Annual Frequency of Application	Unit Cost $/km/Annum
Oil (low)	0.140	4 546	1	636
Oil (high)	0.170	31 822	2	10 819
Oil (mean)	0.165	8 231	1.08	1 467
CaCl (low)	0.100	941	1	94
CaCl (high)	0.154	9 092	5	7 001
CaCl (mean)	0.150	2 466	1.51	559

Source: Costs from survey
Application rate and frequency from Gillham, 1985.

2.4. System Description

The costs of lubricating, transmission and mineral oil are a small component of total costs of operating a vehicle and of industrial processes. Consequently, the quantity of waste oil generated depends more on the levels of vehicle operation and industrial activity than on the price of oil.

Whether or not the oil is collected depends on whether or not there are collectors willing to pay to remove waste oil, or regulatory requirements (which are enforced) requiring generators of waste oil to demonstrate that the oil they generate has been disposed of in an acceptable manner.

The collectors determine the destination of the oil, so much so in fact that the key to the survival of the re-refiners and road oilers is to gain control over waste oil collection. In southern Ontario, the re-refiners have gained control over collection of much of the oil.

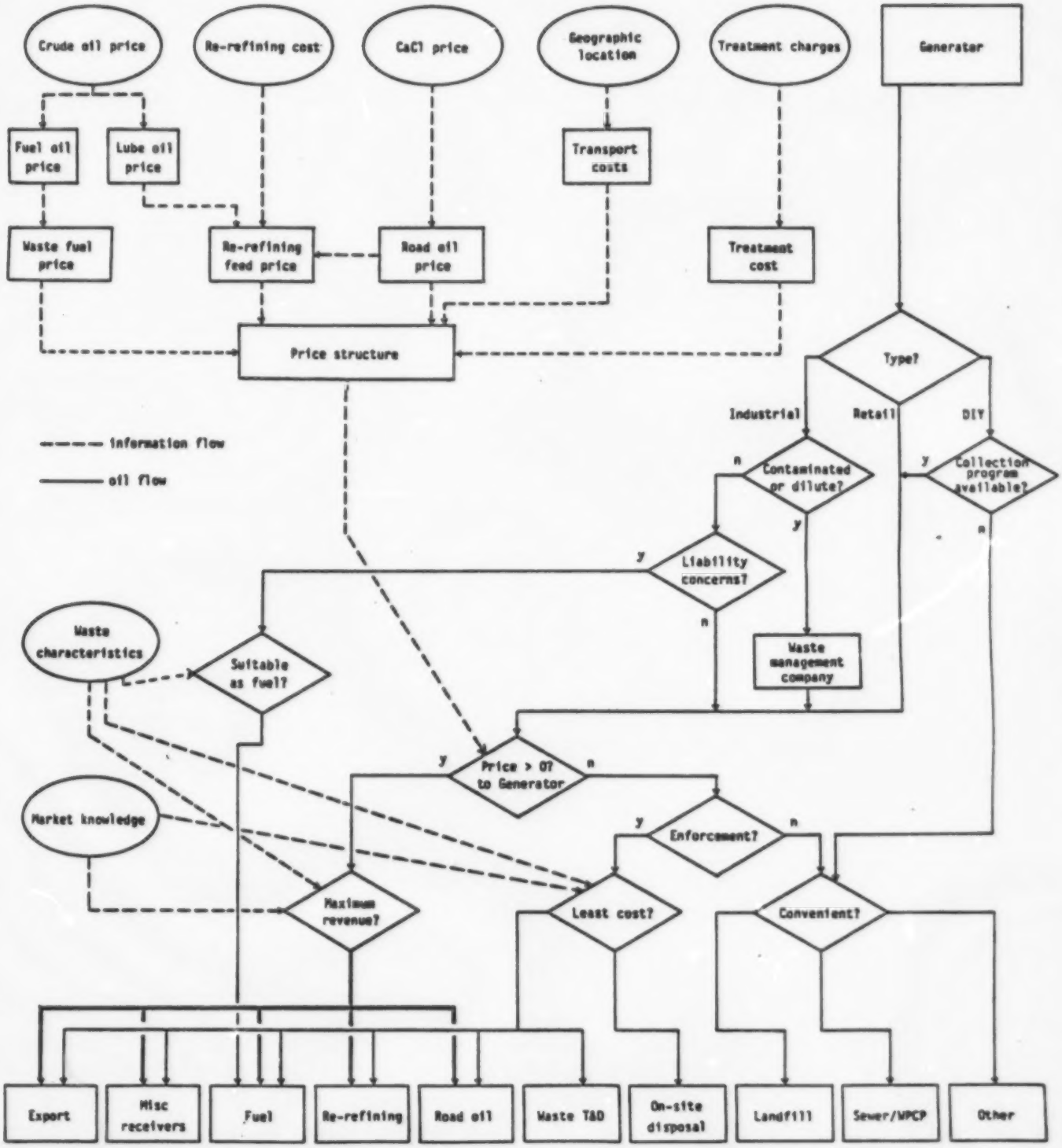
In the case of waste oil from Northern Ontario, the distance to the re-refiners is too great, and it is easier and cheaper for the re-refiners to import waste oil from the United States or Quebec. The demand for oil for road oiling in the north exceeds the supply and thus generators are paid for their waste oil, in spite of depressed world oil prices. Consequently, most of the oil collected in Northern Ontario is used as a dust suppressant.

Figure 1 illustrates the key components determining the fate of oil. In general, decisions among fates are made on the basis of cost. Where the waste characteristics are such that the waste is suitable, it will go to the fate which pays the greatest amount for it (after taking into account collection and transport costs). Where the generator must pay for the removal of waste, a lack of regulatory enforcement would increase the likelihood that the waste oil will end up in municipal landfills (MLF), sewer systems or be disposed of in some other way.

The determination of the fate of waste oil is affected by the sector which generates it. Collection systems for oil generated by the do-it-yourself (DIY) market are generally poor. The fate of oil generated in the commercial sector (i.e. automobile service stations) is determined primarily on the basis of cost, but waste oil generated in the industrial sector is directed to different fates depending on the characteristics of the waste stream (i.e. the types of contaminants present and the water content) and concerns about liability.

FIGURE 1

ONTARIO'S WASTE OIL MANAGEMENT SYSTEM



CHAPTER 3.

MANAGEMENT OPTIONS FOR WASTE OIL

This chapter looks at the reasons why management options are being considered, what the options are, criteria for evaluation and the results of the evaluation.

3.1 Waste Oil - Causes for Concern

Waste oil may contain a wide variety of contaminants, both organic and inorganic, some of which are persistent and are carcinogens. Society has become more concerned about the potential for wastes of all types to contaminate the air and water, particularly where the wastes are deliberately released to the environment (as in road oiling) or are managed using technologies that may not be fully capable of ensuring that persistent compounds are not released (small scale burners). Although Ontario has been fortunate enough to avoid any documented cases of serious environmental impairment associated with the management of waste oil, some others have not been as lucky. The worst case documented to date is that of Times Beach, Missouri, in which dioxin contaminated oil was applied as a dust suppressant leading to severe disruptions in the lives of at least 800 families, and the deaths of some livestock (Sun,1983).

Although standards exist for PCB contamination in waste oil, and all those surveyed indicated that the oil they collected was tested for PCBs before being used, (making an event such as Times Beach unlikely to occur in Ontario), there are many other contaminants in waste oil. In the case of road oiling, a 1985 study done for the Ontario Ministry of the Environment noted that the fate of organic materials in the environment is not well understood, and the potential for groundwater contamination by organic constituents of waste oil remains uncertain (Gillham, 1985). In the case of small scale burners, concern has been expressed that the lead level in waste oil from automobiles leads to unacceptably high exposures when the burners are cleaned out (CARR, 1987).

In light of these uncertainties, it is reasonable for the Ministry to investigate the impacts, both environmental and economic, of implementing more stringent controls on the management of waste oil.

In the Blueprint for Waste Management, the Ministry set out its preferred system for managing wastes, emphasizing reduction, reuse, recovery and recycling, along with safe treatment and disposal. Applying these concerns to waste oil enables the various fates to be ranked as follows:

1 Re-refining
2 Use as a fuel
3 Controlled road oiling

4 Disposal in appropriate waste management facilities
5 Uncontrolled disposal.

Re-refining is a preferred environmental fate because it conserves the material of the oil, and affords control over the fate of the contaminants in the waste oil.

Second ranked is appropriate combustion. Although the value of the oil as a material is lost, the energy value of the oil can be captured. Obviously, to gain this second place ranking, the combustion must occur under controlled conditions which minimize releases of contaminants to the environment.

Controlled road oiling is a form of recovery which extends the usefulness of the waste oil beyond its original use. However, uncontrolled road oiling with its attendant environmental risks is not preferred to disposal in appropriate waste management facilities.

Such disposal, though it may not recover either the material or the energy value of the oil, is preferable to uncontrolled disposal or release to the environment.

3.2 The Management Options

A number of options were identified for addressing the reasons for concern identified above.

- a tighter specification for oil used as a dust suppressant
- a ban on oiling of public roads
- a ban on burning of waste oil
- financial assistance to re-refiners
- incentives for oil collection.

Each of these is described below.

3.2.1 Road Oil Specifications

The current standard for road oil places limits on PCBs (5 ppm), chlorine and bottom sediment and water content. Users of waste oil may have other specifications that their suppliers must meet, including maximum water content and minimum acceptable flash points.

The Ministry of Transportation is in the process of developing a set of environmental guidelines for waste oil being used as a dust suppressant on roads. These will be binding on contractors engaged by MOT, and will likely be adopted by others hiring road oilers. Among the things being

considered is restricting oil permitted to waste type 252.

By setting more stringent specifications on the heavy metal content and organic contaminants in oil that is to be used as a dust suppressant, the Ministry of the Environment could reduce the concerns that have been raised about road oiling.

3.2.2 Prohibition on Road Oiling

An alternative to setting more stringent specifications is a complete prohibition on the use of waste oil as a dust suppressant on roads. This is the approach that has been taken in some other jurisdictions, including the Province of Quebec, New York State, and California (Acres,1987). This option has been advocated by the Canadian Association of Re-refiners (CARR,1987).

3.2.3 Prohibition on Burning Waste Oil

As discussed above, concern has been raised about the burning of waste oil and the resulting emissions, particularly where the oil has been taken from vehicles fueled by leaded gasoline. As an alternative to a total ban, specifications could be set for waste oil to be used as a fuel. If, as set by the Province of Quebec and the United States Environmental Protection Agency, these specifications identify contaminant levels similar to those found in virgin fuels, the effect may be the same as a prohibition, at least for crankcase oils. This option too has been advocated by CARR in its brief to the Ministry (CARR,1987). CARR feels that burning should only be permitted in high temperature rotary kilns, and only where the waste oil is surplus to the demands of re-refiners.

3.2.4 Incentives for Re-refining

The Canadian Association of Re-Refiners (CARR) has requested subsidies for re-refiners that are tied to the price of crude oil. The substance of CARR's arguments are that: re-refiners cannot operate profitably when the price of crude oil drops below U.S.$30 per barrel, re-refining is the most desirable fate for waste oil when environmental and resource-conservation criteria are applied; and if waste oil is not collected for re-refining, a significant portion of it will be dumped into the environment.

3.2.5 Incentives for Collection

A major concern with the current waste oil situation is related to the system for its collection. Firstly, a substantial volume of waste oil is generated by the do-it-yourself (DIY) market. Some estimates suggest that the DIY market accounts for 60 per cent of the automotive market

(CARR,1987). This market is poorly served by the existing collection system, particularly when collectors must charge generators for removing their waste oil.

Secondly, in some circumstances, like those in Northern Ontario, it is the cost of collection and transport to environmentally preferable fates, not the costs of the fates themselves which make those fates uncompetitive. Providing incentives for collection could help address this problem. These could take the form of the Pollution Probe "Oil Drop" program, which already gets some support from the Ministry of the Environment, or they could take a more direct approach through the subsidization of oil collection in related parts of the Province.

3.3 Criteria for Evaluating the Options

In order to assess the economic impacts associated with the options considered, four criteria were developed against which to evaluate the options. These are:

- impact on sources and fates of waste oil
- impact on costs to each sector of the industry (including the Municipalities and generators)
- impact on employment in each sector of the industry
- ease of implementation.

3.3.1 Impact on Sources and Fates

The primary objective of any of the options which might be implemented is to decrease the environmental impacts associated with the management of waste oil. Consequently a primary criterion against which the options should be assessed is the extent to which implementation of the option is likely to lead to a redirection of waste oil to more acceptable fates. In general, options which direct waste to fates higher in the waste management hierarchy identified in section 3.1 are preferred over options which do not do so. This is an indicator of the environmental benefits associated with the option. Detailed characterization of the environmental benefits is necessary to adequately evaluate the options, but is beyond the scope of this study.

3.3.2 Impact On Costs to Each Sector of the Industry

In general, implementation of the waste management options considered will lead to higher costs for the management of waste oil somewhere in the system, otherwise the new option would be expected to be under use already. The magnitude and distribution of these additional costs is an important consideration in evaluating the alternative management options.

3.3.3 Impact on Employment in Each Sector of the Industry

Implementation of the options may affect the number of jobs associated with waste oil management, both in quantity and distribution. The impact on employment and its distribution is the third criterion used to evaluate the options.

3.3.4 Ease of Implementation

Finally, the options are assessed by considering the ease with which they can be implemented. Options which are consistent with existing waste management and regulatory systems are preferred over those requiring fundamentally new ways of doing things.

3.4 Evaluation of the Management Options

In this section, each of the management options described in section 3.2 are evaluated against the criteria outlined in section 3.3.

3.4.1 More Stringent Standard

3.4.1.1 Impact on sources and fates of waste oil

The effects on sources and fates of waste oil depends very much on the content of the standard. If the standard is such that it limits waste oil accepted for use as a dust suppressant to waste class 252, then this would greatly increase competition between the road oilers and the re-refiners. As indicated in Table 4, most of the quantity of waste type 252 sent off site (67 per cent) is sent to re-refiners; dust suppression accounts for about 13 per cent of the total.

However, if the standard sets strict limits on allowable levels of lead and organics, then much more oil would be expected to be directed to re-refiners, since they would have to partially re-refine the oil before it would be suitable for use as a dust suppressant.

3.4.1.2 Impacts on costs to each sector

Generators

Whatever the standard, it is likely that waste oil generators will have to pay more to have their oil taken away. A standard that limits the levels of organics and heavy metals would require oil being used for dust suppression to be transported to re-refineries.

Collectors and Road Oilers

As noted above, the impact of a more stringent standard for road oil cannot be determined unless the content of the standard is known. If, for example, the standard could be met by used engine oils as they are received from the generator, the impact on collectors/road oilers would be minimal. If all oil has to be directed through re-refiners, one would expect Canam to re-enter the dust suppression business, since it was the lack of a standard that was given as the reason for leaving it in the first place. With the dominance of Canam in the marketplace, and their affiliation with Breslube, the second and third tier oilers would likely be hurt by a more stringent standard for two reasons:

- the re-refineries are expected to give preferential access and prices to their own collectors;
- the increased cost of oil as a dust suppressant will encourage some users to switch to other dust suppressants, or to accelerate programs to surface treat roads.

The Re-refiners

The effect of more stringent standards on re-refiners would be felt in different ways depending on the nature of the standard. If the standard contained limits on lead and heavy metals that precluded used engine oils from being used as road oil, it would require that used engine oils be processed to remove the metals, which is the first stage of re-refining. Currently only re-refiners have the capability to remove heavy metals from used oil. A cursory examination of the feasibility of establishing small-scale operations to remove metals from used oil indicated that it is not feasible. Therefore, the standard would confer a near-monopoly on the supply of road oil to the re-refiners.

The Waste Management Industry

Neither this nor any of the other waste oil management options under consideration would have a serious impact on waste management companies. If waste oil could no longer be used for road oiling, the waste management companies currently supplying road oil would have to find an alternative market. In most cases the waste oil would command a lower or negative price in alternative markets, e.g. re-refining or fuel. Since the generator is required by law to safely dispose of any waste oil, the waste management company would be in a strong position to offset any reduction in revenue from disposal of the waste oil by charging the generator more for collection, treatment, and disposal. If generators could not be charged more because of competitive pressures, the waste management company would have to absorb most or all of the increased cost of disposal.

3.4.1.3 Employment impact

No direct impacts on employment are expected from increasing the specification for oil to be used as a dust suppressant. However, it is possible that, as increased costs work their way through the system, there may be some indirect effects.

3.4.1.4 Ease of implementation

All road oil is currently being tested to ensure it meets the current standard before it is applied. Only a few of the road oilers have facilities to do their own testing, but none reported any problems in finding a commercial laboratory to do the testing on their behalf. Increasing the range of contaminants for testing and/or a general tightening of standards, may limit the number of laboratories capable of performing the tests. It may also restrict the use of oil as a dust suppressant to re-refined oils. However, small samples of all oil used as a dust suppressant are currently tested. Monitoring and enforcement is not expected to become more difficult as a result of a more stringent standard.

3.4.2 Ban on Waste Oil for Road Oiling

3.4.2.1 Impact on sources and fates of waste oil

The impact on sources and fates of waste oil of a prohibition on its use as a dust suppressant on roads is different depending on whether Northern or Southern Ontario is being considered. In Northern Ontario, there are no alternative environmentally acceptable fates for waste oil. The oil would first have to be shipped to Southern Ontario or the United States and then someone willing to take it at an acceptable price would have to be found. This will only occur if there is effective enforcement of regulations prohibiting on-site disposal of waste oil (without a waste management system approval) and discharge to sewers or municipal landfills.

In Southern Ontario, where the oil is suitable for re-refining or use as a fuel, it would be directed to those fates. Otherwise, it will require treatment and disposal by the waste management industry.

3.4.2.2 Impacts on costs to each sector

Generators

For waste generated in Northern Ontario, assuming that the waste oil could be given away in Toronto, a collector in, for example, Sudbury would have to stop paying generators two to three cents per litre for waste oil and start charging three to four cents per litre to collect it

plus another four cents per litre to ship it to Toronto. There are approximately 3.3 million litres of waste oil collected by road oilers in Northern Ontario. The additional costs to generators in Northern Ontario would, therefore, be in the order of $300 000.

In addition, there are a number of sources of waste oil which are not suited for use in re-refineries or as a fuel. An example of such a waste is the oil from ships, most of which consists of the residues from the bunker oil purification process. Because of the high concentrations of water and impurities in this waste oil, it is not suitable for refining, fuel, or even as a feedstock for asphalt. The only known, environmentally acceptable fate other than road-oiling for this waste oil is incineration at a hazardous waste disposal facility. If there was a ban on road oiling, the collector, who services the shipping fleet would have to add the transportation and disposal costs involved in sending the waste oil to Tricil for disposal to the amount charged to the ship owners. The cost to incinerate the waste oil is about nine cents per litre. Transportation costs to Tricil's facility from the source of the waste oil is about 3 cents per litre. The additional cost to the shipping industry would be approximately $200 000 per year. The figure does not include additional costs, if any, to treat oily waters from ships' bilges.

Collectors and road oilers

Five of the seven second tier road oilers derive substantially all of their revenue from collecting waste oil and applying it as a dust suppressant. For these companies a ban on waste oil for road oiling would cause severe hardship.

A sixth second tier road oiler derives less than 15 percent of its revenue from road oiling. If a ban on road oiling was imposed it would experience some problems, but they would not pose a serious threat to the future of the organization. Every effort would be made to re-deploy displaced workers into other parts of the operation, but it may become necessary to lay off one or two workers. An attempt would be made to find an alternative fate for the waste oil such as fuel or re-refining. If the company was able to find a suitable alternative fate, and/or raise the price charged to generators so that it was left with a profitable waste oil collection/disposal business, it would continue to collect waste oil. If it could not do so profitably it would stop collecting the oil.

The seventh second tier company derives less than 10 percent of its revenues from road oiling and about 90 percent of the waste oil it collects is sold as fuel. If road oiling was banned, the company would simply sell all of the waste oil that it collects as a fuel.

All but one of the third tier road oilers derive less than 10 per cent of their revenue from road oiling. Most would quit collecting the oil,

since road oiling is really quite peripheral to their main business activities.

In almost all cases, waste oil commands the highest price when it is applied as a road oil. Road oilers typically receive about 17 cents per litre for applying waste oil. Re-refiners might be willing to pay four to five cents per litre at the refinery gate for high quality used oil if their own collection networks cannot meet their needs. Waste oil with high-heat value commands eight to 10 cents per litre at a fuel-blender or burner's gate. Because road oilers earn the bulk of their revenues on application of road oil they are in a position to treat collection as a cost. If road oiling was banned none of the remaining disposal options would provide enough revenues to allow the collectors to operate profitably. If the loss in revenue could not be made up by increasing the fees charged to generators, the collectors would be driven out of the collection business.

When asked what effect a ban on road oiling would have on their used oil collection activities, two of the five collectors/road oilers, who derive substantially all of their revenue from oil collection and road oiling, stated that they would stop collecting oil. Two others stated that they would attempt to find an alternative fate for the waste oil that would allow them to continue to operate profitably. If they could not, they would leave the business.

The fifth company collects waste oil from ships. If the ship owners had no choice other than to pay the additional cost, the collector could remain in business by providing transportation and transfer station services.

Of the other four collector/road oilers, two collect oil in Southern Ontario and two in Northern Ontario. The prospects for being able to survive as oil collectors/transfer station operators are not particularly good for any of them. One in Southern Ontario and one in Northern Ontario have indicated that they would not even try to remain in business; they would simply close their doors if a road oiling ban was imposed.

The two collectors/road oilers collecting waste oil in Southern Ontario have little leeway to increase the amount charged to the generators since they are competing with re-refiners for the used oil. Therefore, any loss in revenues from discontinued road oiling operations would have to be made up by selling the waste oil for other uses. This would be very difficult since re-refiners are currently not willing to pay for waste oil from sources other than their affiliated companies and there are few outlets for waste oil as a fuel. In most cases waste oil has to be blended with other materials before it is suitable as a fuel. There are no large-scale blending facilities in Ontario. The waste oil would, therefore, have to be shipped to the United States and the transportation costs would have to be covered.

If the two collectors/road oilers stopped collecting oil in Southern

Ontario, it is expected that other collectors, for example, waste management companies and re-refiners would move in to provide a collection service to the generators previously served by the collectors/road oilers. The cost to the generators to dispose of used oil may ultimately rise, but not high enough or soon enough to help the collectors/road oilers.

Re-refiners

While about half of the waste oil that is used as a dust suppressant could be re-refined, CARR does not see a ban on road oiling as the solution to its members' problems. If the ban were put in place only a portion of the waste oil that previously went to road oiling would find its way to the re-refiners. The amount involved would be too small to significantly reduce the average cost at the refinery gate of waste oil. For these reasons, CARR maintains that subsidies to the re-refiners are necessary.

Municipalities

As noted in Chapter 2, municipalities who contract to have their roads oiled perceive that oil is a cheaper and more effective material. However, most were unable to speculate about how they would respond to a ban on road oiling; many of those who identified Canam as the supplier they used had not yet determined how they will respond to Canam's withdrawal from the market. Most of those who could speculate, perceived that they have little choice but to substitute calcium chloride, at least in the short-term, since other materials were not available, or were not acceptable for use in their jurisdiction. Over the longer term, other options that might be considered included surface treating more roads, or substituting dust suppressants that are being developed from virgin materials.

At the average application costs for oil and calcium chloride, Ontario users of waste oil as a dust suppressant would be expected to save 1.7 million dollars per year by switching from oil to calcium chloride. However, many of those users would be expected to require the higher application rates and frequencies for calcium chloride because of soil conditions less amenable to use of calcium chloride. For example, the region with the highest reported use of oil is the District of Muskoka which is typically characterized by sandy soils that are least suited to using calcium chloride. The manifest system indicated that 3.2 million litres of oil were used from July 1, 1986, to June 30, 1987, (see Table 6). Based on the surveys of municipalities, 2 million of these litres were used by the six municipalities in the District at a cost of $316 000. If the high end of the range of application rates and frequencies for calcium chloride are used, then the incremental cost of switching from oil to calcium is almost 1.4 million dollars per year. Applying the same assumptions to the province as a whole suggests an upper limit estimate on the costs to road oil users of 9.2 million dollars per year.

There are a number of ways of reducing this upper limit estimate of the costs of banning road oil. The effectiveness of calcium chloride can be increased by grading about 5 cm of fine materials into the road. Alternatively, MTC could relax its requirements for allowable dirt in gravel. Both of these would increase the effectiveness of calcium chloride, and thus allow the application rate and/or frequency to be reduced.

Surface treating roads could reduce the need for any type of dust suppressant. The Town of Huntsville has been able to reduce its costs for road oiling from about $200 000 per year a few years ago to a projected amount of $50 000 next year by surface treating roads using an asphaltic emulsion at a cost of between $10 000 and $11 000 per kilometer (Macdonald,1987). If this technique could be applied to all roads currently being oiled in the District of Muskoka, and if the surface treatment lasts about five years, then the incremental cost (at an interest rate of 6 per cent) is estimated at only $180 000 per year (a fifty per cent increase over current costs). Applying these assumptions to the province suggests an incremental annual cost of 1.4 million dollars (about 33 percent higher) from a ban on road oiling.

Municipalities pay for dust suppressants from their road maintenance budget. The Ministry of Transportation provides grants for this purpose which cover about half of the costs, and therefore additional costs associated with the use of alternative dust suppressants will be distributed roughly equally between the provincial and municipal governments.

3.4.2.3 Employment impact

Under current conditions it would be virtually impossible for a waste oil collector to survive in Northern Ontario if he could not generate income from road oiling.

Using alternate dust suppressants was not seen as a feasible option by these collectors; the six largest road oilers advised that it would be very difficult for the following reasons:

- **Equipment costs:** The most popular dust suppressant is calcium chloride, which is corrosive. The equipment currently used to spread used oil would require extensive modifications to be suitable for calcium chloride. If the five collectors/road oilers who derive all of their revenues from collecting waste oil and applying it as road oil could no longer collect oil, they would have to find other means of generating income for their staff and equipment during the eight to nine months of the year that dust suppression is not necessary.

- **Price/performance:** Most of the road oilers have tried other dust suppressants in the past but none were thought to be as good as road

oil on the basis of price, performance and customer acceptability.

- **Price/availability of calcium chloride.** The supply of calcium chloride in Ontario is controlled by one manufacturer and a small number of distributors. However, one interviewee reported a potential, competitive U.S. source of calcium chloride. One road oiler reported that the price quoted to him for calcium chloride was the same as the price charged to a municipality for spreading the same amount on the road. Another road oiler reported that the supplier refused to sell calcium chloride to him.

The smaller road oilers considered it technically feasible to apply alternative dust suppressants but were generally either uninterested in doing so, or concerned about the availability to them of supplies of effective alternatives.

For these reasons it is unlikely that any of the collectors/road oilers will be able to continue to maintain a profitable business by simply switching to an alternative dust suppressant.

Of the five collectors/road oilers who earn substantially all of their income from collecting waste oil and applying it as a dust suppressant, only the one servicing the shipping industry has a reasonable chance of surviving as either a waste oil collector or applicator of dust suppressants if road oiling is banned. The companies that are likely to fail employ approximately 21 people.

3.4.2.4 Ease of implementation

Waste oil management in Northern Ontario will be particularly difficult if road oiling is banned. In order for alternative fates such as re-refining or burning in high-temperature rotary kilns to be feasible, the waste oil must be transported to Southern Ontario at an incremental cost of about 10 cents per litre. Generators will not willingly pay the additional cost. In the past when collectors attempted to stop paying generators for waste oil and charge them instead, generators reportedly found "imaginative" zero-cost disposal options. If road oiling is banned, action must be taken concurrently to ensure that used oil is safely disposed of in North Ontario. Such action may include: strict enforcement of existing regulations so that generators are obliged to pay the full cost of disposing of the waste oil in Southern Ontario or the United States, provision of government funds to subsidize the transportation and disposal costs, and allowing waste oil to be burned in small furnaces, assuming that the technology is available to do so in a manner that is environmentally acceptable.

3.4.3 Prohibition of Using Waste Oil as a Fuel

3.4.3.1 Impact on sources and fates of waste oil

A prohibition on the use of waste oil as a fuel would not have a significant effect on the sources and fates of waste oil. Very small quantities of waste oil are legally burned in small scale burners, and it is unlikely that the prohibition would apply to oil burned in rotary kilns. Even if CARR's suggestion is adopted that burning in high temperature incinerators be permitted only if the supply is surplus to the re-refiners needs, the effect would be minimal since much of the waste oil burned as fuel or re-refined is imported from the United States and Quebec.

3.4.3.2 Impacts on costs to each sector

The Re-refiners

While most of the waste oil that is currently being burned could be re-refined, CARR does not see curbs on burning waste oil as a solution to its members' problems. If the curbs were put in place only a portion of the waste oil that previously went to the fuel market would find its way to the re-refiners. The amount involved would be too small to significantly reduce the average cost at the refinery gate of waste oil. For these reasons, CARR maintains that subsidies to the re-refiners are necessary.

The Waste Management Industry

The waste oil handled by waste management companies that becomes a fuel goes to a fuel blender for processing and is typically then shipped to a cement plant or asphalt plant where it is burned in rotary kilns that operate under Ministry of the Environment certificates of approval. A ban on burning of waste oil would not apply to licensed rotary kilns.

3.4.3.3 Employment impact

Given the minor effect on fates and quantities, the impact of a ban on use of used oil as a fuel would have a small impact on employment. Worst hit would be the suppliers of used oil burning equipment.

3.4.3.4 Ease of implementation

Given that a relatively small number of users are affected, and there are readily available alternatives, this option is not seen as difficult to implement.

3.4.4 Subsidies to Re-refiners

3.4.4.1 Impact on sources and fates of waste oil

The Canadian Association of Re-refiners has presented a brief to the Ontario Ministry of the Environment indicating a need for financial assistance:

> "Because of the current price of crude oil, as well as other business changes, it is not economically feasible to re-refine used oil. This appendix indicates the level of financial assistance required based on the price of crude oil. Without this financial assistance, there is a real possibility that all operating re-refineries will close. If this were to happen, all of the used oil currently being re-refined could potentially be mismanaged and Canada would lose at least 1,000 jobs." (CARR, 1987)

In order to assess this option, it is necessary to consider two cases: probable sources and fates of waste oil, and the effect on these of providing a subsidy to the re-refiners.

There is currently approximately 75 million litres of waste oil that is suitable for re-refining collected in Ontario each year. Of the 75 million litres, approximately 90 percent is currently being re-refined and the remainder is used either as a dust suppressant or fuel. The demand for waste oil in Ontario exceeds the supply that can be economically collected in Ontario by a wide margin. To fill the gap, approximately one half of Ontario's re-refined waste oil requirements are met by Quebec and the United States. Because other users of waste oil can typically afford to pay more for it than can the re-refiners, it is the re-refiners who use most of the imported oil.

Regulation 309 of the Environmental Protection Act classifies waste oil as a waste and thus requires proper management. Assuming that the Ministry of the Environment maintains its level of enforcement of regulations that govern disposal of waste oil, generators will be obliged to find another collector. Mismanagement of oil would only be expected if the enforcement of the regulations is reduced, or if no collectors are able and willing to collect the oil.

Particularly now, when the demand for waste oil exceeds the supply, oil that is being collected will continue to be collected, whether by a re-refiner, road oiler or supplier of fuel. The net effect of reduced collection by one sector will not be the end of collection, but the replacement of imported waste oil by less expensive Ontario sources.

At current prices, and without financial assistance, Oil Canada advises that it will close its refinery and leave the oil collection business. The only part of the organization that would be likely to survive is the laboratory, which would become wholly-dependent on outside work for its revenue. (Oil Canada already does analyses for several of the road oilers.)

When asked about the importance of subsidies to the future of Breslube's

operations, its spokesman replied that while some level of subsidies are desirable at current crude oil prices, it was unlikely that the Breslube refinery would be closed if subsidies were not forthcoming. If crude oil prices fall lower and market conditions are such that Breslube is forced to close its refinery, its affiliated companies would continue to collect waste oil as long as it was economically feasible to do so. The oil would likely be sold in the fuel market. To make this feasible, generators would likely have to pay more to dispose of their waste oil since it has a lower economic value to burners than to re-refiners. The difference would have to be made up by the generators. Assuming that the Ministry of the Environment enforces existing regulations governing the disposal of used oil, generators would be obliged to pay the additional cost. Enforcement of the regulations would be more difficult in Northern Ontario, but as noted above, only a small portion of the waste oil generated in Northern Ontario is currently being re-refined.

Given the nature of Corundol's operation, its future is unlikely to depend upon the presence or absence of subsidies. Corundol is not a member of CARR, and has not taken a position on subsidies. However, if subsidies were available, Corundol might be encouraged to move into refining used crankcase oil into end products. Corundol has virtually completed construction of a second phase at its refinery that would add 14 million litres per year to its capacity. This capacity is tailored to re-refining crankcase oils into end products; i.e. to the markets served by Breslube and Oil Canada. Corundol has mothballed the additional capacity because it cannot be operated profitably at current crude oil prices. If subsidies were available that would enable Corundol to operate profitably, the additional capacity would likely be brought on stream.

This suggests that without subsidies, only Oil Canada will close its gates, and the oil that it is re-refining will be collected by other waste oil users to displace imports. Since most of the imported oil is already going to re-refining, the effect on fates of Ontario oil of continuing without a subsidy to oil re-refiners is not expected to be significant. The loss of 40 million litres per year of re-refining capacity will still leave Ontario with more than adequate capacity to re-refine the waste oil that is generated and collected in Ontario. Even with a total ban on the use of waste oil for road oiling or as a fuel, an additional 35 million litres of used oil would have to be collected before the amount of oil collected in Ontario was equal to the re-refining capacity of Breslube and Corundol.

With subsidies, all Ontario re-refiners could continue to operate, but to do so more profitably. Subsidies to re-refiners would not, in themselves,encourage development of the infrastructure to collect oil from under-serviced segments; e.g. DIY and Northern Ontario.

3.4.4.2 Impacts on costs to each sector

The Generators

The purpose of subsidies is not seen as to making re-refineries more competitive than other fates of waste oil, and thus subsidies are not expected to reduce costs to used oil generators. However, with subsidies, the re-refiners could afford to pay generators more (or charge them less) for their waste oil.

Road oilers and fuel suppliers

The purpose of subsidies, as requested by CARR, is not to divert waste oil from existing fates to re-refining, but to prevent the loss of re-refining as an option. This analysis suggests that, without subsidies, two of the three re-refiners will continue operating, with adequate capacity to handle all the Ontario oil currently being re-refined. Consequently, the size and nature of subsidies is not expected to have an impact on the costs faced by road oilers, fuel suppliers, and other users of waste oil.

The Waste Management Industry

Financial assistance to re-refiners would likely benefit waste management companies. With financial assistance, re-refiners would be in a much better position to pay, rather than charge, waste management companies for their waste oil.

Users of re-refined oil

Subsidies to re-refiners would not reduce costs to users of re-refined oil. It is the re-refiners' inability to adjust prices of their product to cover costs that leads to the need for a subsidy in the first place.

3.4.4.3 Employment impact

Re-refiners

If no financial assistance to the re-refining industry is provided, it is expected that Oil Canada will close its refinery and leave the oil collection business. The immediate consequences would be the loss of about 50 jobs (fewer if the laboratory survives as a contract facility). Providing subsidies would prevent this job loss.

Employment at the other two re-refineries -- Breslube and Corundol -- is not expected to be affected by the subsidies.

Other sectors

Employment in other sectors of the Ontario waste oil industry is not expected to be affected by the provision of subsidies to re-refiners.

3.4.4.4 Ease of implementation

Direct subsidies to re-refiners, based upon the price of crude oil, would allow all three of Ontario's re-refiners to remain in operation. This assumes, of course, that the subsidies are high enough to allow the re-refiners to operate at a profit. To do so, the entire throughput of the re-refineries would have to be subsidized. Since more than 50 percent of the re-refiners' waste oil feedstock comes from Quebec and the United States, three difficult questions must be answered prior to implementation of subsidies to re-refiners.

The first question that must be addressed is which jurisdiction should pay the subsidies? If Ontario agreed to pay its proportionate share and the other jurisdictions did not, the financial assistance would probably not be high enough to keep all three re-refiners open. If Ontario provided subsidies that were high enough to allow the re-refiners to operate profitably, Ontario would not only be subsidizing re-refiners, but also used oil generators in Quebec and the United States.

The second question that must be addressed is the amount of the subsidy. While financial data for the re-refiners is not available, if subsidies are paid on the basis of cents per litre of throughput, as suggested by CARR, it is highly likely that the amount per litre required to keep one re-refinery open would represent a windfall to another.

Finally, will providing subsidies to re-refiners help the Ministry of the Environment to meet its goals? As noted above, Ontario could lose one refinery and still have adequate capacity to re-refine all of the waste oil generated in Ontario that is suitable for re-refining. Subsidies to re-refiners would not, in themselves, encourage the development of the infrastructure to collect oil from under-serviced segments; e.g. DIY and Northern Ontario. The subsidies would simply allow re-refiners to continue their current operating practices, but to do so more profitably.

3.4.5 Subsidies to Collectors

3.4.5.1 Impact on sources and fates of waste oil

Targeted subsidies, aimed at collecting more waste oil from under-serviced segments (e.g. DIY and Northern Ontario), would increase the amount of waste oil collected in Ontario. The subsidies would make some collection activities that were not previously economically feasible more attractive.

The demand for waste oil in Ontario exceeds the supply that can be economically collected in Ontario by a wide margin. To fill the gap, approximately one half of Ontario's used oil requirements are met by Quebec and the United States. The practice of re-refiners and other users of waste oil is to go as far afield as necessary to collect the amount of oil that they require. Indeed, one of the major reasons that re-refiners are having financial difficulties is the high cost of transportation of waste oil. For these reasons there is a great deal of competition for nearby sources of used oil.

3.4.5.2 Impacts on costs to each sector

Generators

If a subsidy to collectors was offered for all waste oil collected in Ontario, the collectors, including the re-refiners, would likely end up sharing the benefits with generators. This, in turn, would provide further incentive for the generator to ensure that waste oil was stored for collection.

Re-refiners

Whether subsidies to collectors would benefit re-refiners or not depends on a number of factors, including: the level of subsidies, the amount that is collected, and the degree of competition for the waste oil for other uses such as road oil or fuel.

Subsidies to waste oil collectors may reduce the cost of waste oil to re-refiners and, depending on how the subsidy program was structured, may result in more waste oil being collected in Ontario. As noted above, the two largest re-refineries collect the great bulk of their waste oil requirements through collection networks that they control. Since there is considerable competition for waste oil in Ontario, the financially strongest re-refiner/collector would likely pass on some of the subsidy to generators in the form of reduced charges to service stations to take away their waste oil and higher prices paid to large generators. In this way the re-refiner could not only reduce his cost for oil collected in Ontario, it would also allow an increase in the amount of waste oil collected in Ontario and decrease the amount of more expensive waste oil that is brought in from out-of-province.

At the new market equilibrium price for waste oil that results if a subsidy program is implemented, the financially-weak re-refiner/collector may not be much better off than without subsidies. If some of his Ontario market share of used oil is lost to a financially-stronger competitor he will have to bring in more oil from out-of-province or reduce his operating capacity. In either case his costs will increase, and some or all of the gains from the subsidy will be eliminated.

Other waste oil using sectors

The effect on costs of waste oil to road oilers and fuel collectors is to reduce their costs of collection.

Users of products of the waste oil industry

Municipalities contracting for road oiling and fuel users would likely see some cost savings associated with subsidies to collectors. However, these are expected to be relatively minor. Subsidies would be designed to make collecting oil which is not now collected only slightly less expensive than importing oil. For the most part, road oilers and fuel users are already using oil that is less expensive than imported oil, which is used primarily by the re-refiners.

Users of re-refined oil would not be expected to realize any cost savings from subsidies provided to collectors.

3.4.5.3 Employment impact

Sectors involved in the collection of oil would be expected to see a modest increase in employment in order to collect additional oil.

3.4.5.4 Ease of implementation

An across the board subsidy to collection would lead to the greatest subsidy being provided to fates which are already quite profitable, and which tend to be fates which are less desirable from an environmental perspective. Ideally, the preferred system of subsidy would be targeted at the markets not now served by the waste oil industry, and would direct these wastes to the preferred destinations. Designing such a system will be a challenge.

3.5 Summary

The evaluation of the five options against the criteria is summarized in Table 9.

TABLE 9

Summary of the Evaluation of the Management Options

CRITERION	MANAGEMENT OPTIONS				
	Tighter Specification for road oil	Prohibition of road oiling	Used oil fuel specifications	Subsidies to re-refiners	Subsidies to used oil collectors
1. Impact on sources and fates of used oil	Depends on the specification. If demetallizing required, benefits re-refiners. If only 252 permitted, increases competition for that class of oil.	Re-directs oil to re-refiners and fuel uses, displacing imports.	No significant effects on sources and fates	No significant effects on sources and fates.	Increases Ontario oil collected, and decreases imports for re-refining.
2. Impacts on costs to each sector	Generators pay more, second and third tier road oilers have trouble competing. Re-refiners benefit if all road oil must be treated before use, but suffer if their supply of waste type 252 is reduced.	Generators' costs are increased: e.g. $300 000 in Northern Ontario, $200 000 to the shipping industry. Severe hardships for five second tier road oilers. Dust suppression costs for municipalities increased by up to $9.2 million per year.	Small generators burning used oil on-site will have to pay more for virgin fuel.	Oil Canada avoids going out of business; other re-refiners become profitable.	Financially strong collectors better off; weak suffer. Generators' costs reduced.
3. Impact on employment in each sector.	Not significant	Loss of 21 jobs in the road oiling industry.	Loss of jobs in equipment supply industry.	Avoids loss of about 50 jobs.	Some increased employment to collect previously uncollected oil.
4. Ease of implementation	Extension of existing practices.	Difficult in Northern Ontario where few alternative fates available. Difficult for municipalities with sandy soils.	Not difficult	Difficult to distribute subsidies to avoid subsidizing out-of-province oil.	Difficult to avoid subsidizing areas not needing subsidies.

CHAPTER 4.

CONCLUSION

4.1. Findings

This study has considered the used oil quantities and fates, the structure and functioning of the used oil system, and the likely economic effects of a range of possible management options. Major findings can be grouped into four groups:

* those concerning quantities and fates
* those concerning the structure and functioning of the road oiling industry
* those concerning the economic viability of the re-refining industry
* those concerning the used oil management options considered

4.1.1. Quantities and Fates

4.1.1.1. Most oil is collected

Of the 250 million litres of waste oil generated in Ontario per year, most oil is collected or diposed of on site. Most of the oil which is not collected is from the do-it-yourself market, some resource industries in Northern Ontario, and sparsely populated areas. The total amount of waste oil collected is about 150 million litres per year.

4.1.1.2. Most collected oil is re-refined

Re-refining receives more of the collected oil than any other fate(43%). Other fates of the collected oil include: dust suppression (25%); fuel (1%); export (5%); waste treatment and disposal, including WPCPs (5%); landfill (5%) and "miscellaneous receivers" (10%). Between six and seven per cent is sent to other unspecified destinations.

4.1.1.3. Imported oil is re-refined

Approximately 55 per cent of the used oil that is re-refined in Ontario is imported. This amounts to 75 million litres, of which 53 million litres are from the United States, and 22 million litres are from Quebec.

4.1.1.4. Exported oil is burned as a fuel supplement

Approximately 7 million litres of used oil is exported, primarily for burning as fuel in the United States.

4.1.2. The Road Oiling Industry

4.1.2.1. Canam Oil Services dominates road oiling in Ontario

One firm, Canam Oil Services, accounted for approximately 56 per cent of the oil supplied for road oiling in Ontario in recent years. Another 7 companies account for 40 per cent of the oil used for dust suppression, and the remaining 4 per cent is applied by another 18 companies and government agencies. In August 1987, Canam announced that it will no longer offer dust suppression services (road oiling). In general, municipalities who use oil for dust suppression and who have contracted with Canam for this service have not yet decided what actions they will take now that Canam has withdrawn from the business.

4.1.2.2. Few companies rely on road oiling as their main form of business

About 30 companies have applied to the Ontario Ministry of the Environment for approval to apply waste oil to public roads for dust suppression. Of these companies, only five rely on road oiling as their main form of business. These five companies employ 21 people.

4.1.3. The Re-Refining Industry

4.1.3.1. Some re-refiners are in dire straits

Two companies are re-refining waste oil in Ontario: Breslube and Oil Canada. In addition, Corundol Oil has the capability of beginning re-refining of waste oil on short notice, but operates primarily as a custom oil cleaner and blender. Oil Canada reports that without a subsidy (estimated at 0.06 $/L) they will close. If Oil Canada closes, Breslube will probably take all the waste oil being re-refined at Oil Canada and reduce out-of-province imports.

4.1.3.2. If all re-refiners close, oil will still be collected

The Canadian Association of Re-Refiners has submitted a brief to the Ontario Ministry of the Environment which states that re-refiners should be subsidized to prevent industry closings which will lead to the disposal of waste oil in unacceptable ways. The present study has found that if all re-refiners closed, and with enforcement of regulations by the Ministry of the Environment, the waste oil would still be collected and sold as fuel to companies that can consume all of the waste oil now being collected. Although use as a fuel is identified as a less desirable fate than re-refining, it is still environmentally acceptable.

The consequence of all re-refiners closing will be an increase in the price of waste oil disposal to generators, and a shift in the revenue source of collectors/re-refiners from end-use to collection.

4.1.4. Waste Oil Management Options

4.1.4.1. Environmental concerns about road oiling may be met by introducing waste oil specifications

If tighter specifications were introduced for oil to be used as a dust suppressant, this product could be produced by the re-refiners. It is also possible that road oil would be produced from virgin oil by major oil companies. Tighter specifications would increase the cost of road oiling to the municipalities who would seek alternatives and small operators might be driven out.

4.1.4.2. The consequences of a ban on road oiling are the dislocation of 21 employees, and an increase in cost and/or loss of performance for municipalities

If road oiling is banned, collector/oilers for whom this is the only occupation and who employ an estimated 21 people, expect to go out of business. However, an alternative outcome is that with Ministry of the Environment enforcement (difficult in the North) generators will pay more for collection and thus offset the loss in revenue from road oiling. Even if they do go out of business (because they are unable to adjust to the new circumstances), it is likely that another collector will move in and the oil will be directed to a different fate.

Municipalities who use oil for dust suppression indicate that they do so either because it is cheaper, or because it is more effective than the alternatives under certain soil conditions. Alternative dust suppressants (notably CaCl) are available, but under some conditions are more expensive or less effective. Some municipalities with soil conditions which are not conducive to the use of CaCl are implementing a program of surface treating roads with an asphaltic product. An upper

limit estimate of the costs to municipalities of using other products in place of used oil for dust suppression is 9.2 million dollars per year.

4.2 Recommendations

It would be out of place to make recommendations on which, if any, of the waste oil management options considered in this study should be adopted in the absence of a full examination of the benefits likely to ensue. However, three specific recommendations do emerge from the work that has been undertaken.

4.2.1 Monitor the effects of Canam's withdrawal from road oiling.

As the largest road oiler in Ontario, Canam's decision to cease road oiling provides an unusual opportunity for the Ministry to study the consequences of what is equivalent to a partial ban on road oiling.

4.2.2 Technical studies of dust suppression on sandy soils

Further studies should be undertaken to ascertain the relative advantages and disadvantages of the various dust suppression materials. A high degree of uncertainty remains with respect to whether municipalities will save money or incur increased costs if road oil is banned. Much of this uncertainty relates to the relative performance and, hence, application rates, of waste oil and calcium chloride on sandy soils.

4.2.3 More detailed treatment of the management options

If the Ministry decides to pursue one or more of the management options considered in this study, then a more detailed examination of modes of implementation should be undertaken. With respect to banning road oiling, consideration should be given to phasing in the ban and/or to implementing a ban on oils where fewer substitutes are available as alternatives to an immediate, outright ban. Such an approach would ease the adjustment of those adversely affected by the measure and still yield environmental benefits.

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APPENDIX A

TABLE A-1
On-site Management of Waste Oil
(kg/a)

	251	252	253	254	TOTAL
Sanitary sewer	163 920		5 460		169 380
OWRA Facility	385	2 340		1 725 960	1 728 685
Part V Facility	6 960 000	4 330 700			11 290 700
Landfill	6 906 200	76 227			6 982 427
Landfarming	739 400				739 400
Dust Suppression	5 525 780	2 003 027	14 029 016	2 628 120	24 185 943
Incinerator	626 000	1 858 498	3 571 720		6 056 218
Waste Derived Fuel		673 116			673 116
Storage	131 763	1 528 952	2 330		1 663 045
On-site Total	21 053 448	10 472 860	17 608 526	4 354 080	53 488 914

Source: Ontario Ministry of the Environment, Generator Registration Data.

TABLE A-2
Manifested Transfers to Final Destinations
(kg/a)

	251	252	253	254	TOT
GENERATORS TO FINAL DESTINATIONS					
Landfill	1 174 708	551 102	47 957	228	1 773 9
Private landfill	11 995 818	22 094			12 017 9
Incinerator	2 210 544	340 425	572 953	232 698	3 356 6
WPCP	6 232 023	89 497	566 304	276 589	7 164 4
Export	436 827	1 366 506	1 312 783	56 147	3 172 2
Dust suppression	202 145	450 761	1 440 947	4 717 183	6 811 0
Misc. receivers	604 143	1 502 789	1 906 991	1 047 540	5 061 4
Re-refiners	3 008 935	18 707 102	1 933 324	9 214 632	32 863 9
Total	25 865 143	23 030 276	7 781 259	15 545 017	72 221 6
INTERMEDIATE TO FINAL DESTINATIONS					
Landfill	4 860 438	291 389		565 646	5 717 4
Private landfill			137 410	290 964	428 3
Incinerator	119 502	25 025	1 099 387	163 800	1 407 7
WPCP			1 828 112	19 224 197	21 052 3
Export	200	982 314	35 592	2 895 542	3 913 6
Dust suppression	1 529 607	3 218 681	11 536 735	14 864 784	31 149 8
Dust suppression (fuel)				15 750	15 7
Misc. receivers (non-fuel)	124 798	283 324	550 053	8 355 376	9 313 5
Misc. receivers (fuel)			40 000	1 155 195	1 195 1
Total	6 634 545	4 800 733	15 227 289	47 531 254	74 193 8
TOTAL TO FINAL DESTINATIONS					
Landfill	6 035 146	842 491	47 957	565 874	7 491 4
Private landfill	11 995 818	22 094	137 410	290 964	12 446 2
Incinerator	2 330 046	365 450	1 672 340	396 498	4 764 3
WPCP	6 232 023	89 497	2 394 416	19 500 786	28 216 7
Export	437 027	2 348 820	1 348 375	2 951 689	7 085 9
Dust suppression (non-fuel)	1 731 752	3 669 442	12 977 682	19 581 967	37 960 8
Misc. receivers (non-fuel)	728 941	1 786 113	2 457 044	9 402 916	14 375 0
Re-refiners	3 008 935	18 707 102	1 933 324	9 214 632	32 863 9
Fuel			40 000	1 170 945	1 210 9
Total	32 499 688	27 831 009	23 008 548	63 076 271	146 415 5

TABLE A-2
(continued)

Notes:

1. Data are from the Ontario Ministry of the Environment manifest system for the period 1 July 1986 to 30 June 1987.

2. The same waste may be manifested more than once if it goes to an intermediate destination. This table accounts for the waste as received at final destinations, including re-refiners. The manifest system database for the period also reports an additional quantity of 126 567 503 kg/a which was shipped to intermediate destinations such as transfer stations.

3. Also reported was 60 746 077 kg of imports of waste types 251 through 254.

TABLE A-3

ASSUMED CONVERSION FACTORS

	Density L/kg	Oil Fraction
Sanitary sewer	1.0	0.1
OWRA Facility	1.0	0.1
Part V Facility	1.0	0.4
Landfill	0.9	0.4
Landfarming	1.0	0.4
Dust Suppression	1.1	0.9
Incinerator	1.1	0.9
Waste Derived Fuel	1.1	0.9
Storage	1.0	0.9
Private landfill	0.9	0.4
WPCP	1.0	0.1
Export	1.1	0.9
Misc. receivers	1.1	0.9
Re-refiners	1.1	0.9
Fuel	1.1	0.9

Notes: Densities and the oil fraction of waste oils varies with individual waste streams. The above values are estimates used in the text to convert waste types measured in kilograms into volume units of oil.